CLAIMS:

1. A cable modem connected to a cable transmission system to communicate with a cable modem termination system that has a master clock operating at a system frequency, the cable modem comprising:

a frequency controllable oscillator;

a demodulator for receiving messages representative of the system frequency;

a comparator for generating an error signal representative of the difference between the oscillator frequency and the system frequency represented by the messages;

a loop filter having an input to which the error signal is applied and an output that is applied to the oscillator to control its frequency, the loop filter having initial coefficients that define a large bandwidth; and

a controller that adjusts the loop filter to have coefficients that define a small bandwidth when the error signal drops below a threshold level.

2. The cable modem of claim 1, in which the loop filter comprises a linear loop having linear coefficients and an integral loop having integral coefficients and the controller adjusts both the linear coefficients and the integral coefficients when the error signal drops below a threshold level.

3. The cable modem of claim 2, additionally comprising a time stamp generating counter connected to the oscillator to generate time stamps that are representative of the oscillator frequency, the messages received by the demodulator are time stamps, and the error signal generated by the comparator represents the difference between the time stamps.

4. The cable modem of claim 3, in which the demodulator receives messages representative of a slot timing offset of the cable modem relative to the cable modem termination system and the slot timing offset messages are added to the time stamps generated by the counter.

5. The cable modem of claim 4, in which the resolution of the timing offset messages is equal to or finer than the resolution of the time stamps generated by the counter.

6. The cable modem of claim 3, additionally comprising an acquisition counter connected to the demodulator to count the number of time stamps received by the demodulator, the controller measures the error signal after the acquisition counter reaches a threshold value, and the controller adjusts the linear and integral coefficients if the measured error signal drop below the threshold level after the acquisition counter reaches the threshold value.

7. The cable modem of claim 6, in which the controller resets the acquisition counter if the measured error signal does not drop below the threshold level after the acquisition counter reaches the threshold value.

8. The cable modem of claim 7, in which the controller compares the state of the acquisition counter with the threshold value, advances the state of the acquisition counter if the state is below the threshold value, measures the error signal if the state is above the threshold value, and adjusts the coefficients if the measured error signal drop below the threshold level.

9. The cable modem of claim 1, additionally comprising a controller for averaging the interarrival time between messages and selecting the coefficients from a table of filter coefficients depending on the average interarrival time.

10. A cable modem connected to a cable transmission system to communicate with a cable modem termination system (CMTS) that has a master clock operating at a system frequency, the cable modem comprising:

a frequency controllable oscillator synchronized to the master clock;

a counter operated by the oscillator to generate a time stamp message representative of the frequency of the master clock;

a timing offset detector for generating a timing offset message representative of the transmission time delay between the cable modem and the CMTS;

a summer for adding the time stamp message and the timing offset message to identify time slots on an upstream channel;

a downstream receiver for processing MAP messages that specify time slots assigned to the cable modem on the upstream channel;

an upstream data queue for storing data to be transmitted upstream; and

an upstream transmitter for transmitting data in the queue on the upstream channel when the time stamp message and the timing offset message identify time slots that match the time slots specified by the MAP messages.

11. The cable modem of claim 10, in which the downstream receiver recovers time stamp messages sent downstream by the CMTS responsive to the master clock, and the cable modem additionally comprises a control loop that adjusts the frequency of the oscillator responsive to the difference between the time stamp

messages sent downstream by the CMTS and time stamp messages generated by the counter to synchronize the oscillator to the master clock.

12. The cable modem of claim 10, in which the downstream receiver recovers a ranging signal sent downstream by the CMTS and the timing offset detector generates the timing offset message from the ranging signal.

13. A cable modem termination system (CMTS) comprising:

a time stamp generator for synchronizing cable modems to each other;

a downstream data queue that has frame boundaries between portions of the data in the queue;

a downstream processor that formats data from the queue into a data stream;

a time stamp send generator for issuing time stamp send commands; and

a downstream transmitter connected to the downstream processor to send the formatted data, connected to the time stamp generator to receive time stamp messages, and connected to the time stamp send generator to insert time stamp messages from the time stamp generator into the data stream responsive to the time stamp send commands.

14. The CMTS of claim 13, in which the time stamp generator comprises a master clock and a counter operated by the master clock to generate time stamp messages that represent the current state of the counter, the downstream processor being connected to the counter to insert time stamp messages from the counter into the data stream responsive to the time stamp send commands.

15. The CMTS of claim 14, in which the time stamp send generator comprise a counter operated by the master clock.

16. The CMTS of claim 15, in which the counter is configured to generate a time stamp send command after the counter reaches a predetermined count.

17. The CMTS of claim 16, in which the predetermined count is programmable.

18. A method for coordinating the transmission of data to a cable headend on an upstream channel of a cable system from one of a plurality of cable subscriber stations located different distances from the headend, the method comprising the steps of:

synchronizing a frequency controllable local clock at the subscriber station to a master clock at the headend;

generating a time stamp message from the local clock representative of the frequency of the master clock;

receiving at the subscriber station a timing correction message generated at the headend, the timing correction message representing the transmission time delay between the one subscriber station and the headend relative to the other subscriber stations;

adding the time stamp message and the timing correction message to define time slots for upstream transmission from the subscriber stations; and

transmitting data from the one subscriber station to the headend in the time slots.

19. The method of claim 18, in which the timing correction message is referenced to the master clock.

20. The method of claim 18, in which the local clock is an oscillator, the step of generating a time stamp message at the subscriber station comprises counting cycles of the oscillator, and the step of synchronizing the local clock to the master clock comprises generating an error signal representative of the difference between the time stamp message generated at the subscriber station and a time stamp message generated at the headend by the master clock and controlling the frequency of the local clock to reduce the difference.

21. The method of claim 20, in which the step of receiving at the subscriber station a timing correction message comprises:

sending a command from the headend to the subscriber station to transmit a timing offset signal at a prescribed time referenced to the subscriber's local clock, there being for each subscriber station an expected time of arrival at the headend based on the distance from the headend;

transmitting the timing offset signal from the subscriber station at the prescribed time referenced to the subscriber's local clock;

receiving the timing offset signal from the subscriber station at the headend;

generating at the headend for the subscriber station a timing correction message, the timing correction message representing the difference between the actual time of arrival of the timing offset signal at the headend and the expected time of arrival referenced to the master clock; and

transmitting the timing correction message for receipt by the subscriber station.

22. In a cable transmission system having a headend, a plurality of cable modems located different distances from the

headend, and a cable network that connects the headend to the cable modems, a combination comprising:

a master clock at the headend;

a local clock at each cable modem;

means for synchronizing each local clock to the master clock;

means for sending from the headend to each cable modem a command to transmit a timing offset signal at a prescribed time referenced to the local clock, there being for each cable modem an expected time of arrival at the headend based on the distance from the headend;

means for transmitting the timing offset signal from each cable modem at the prescribed time referenced to the local clock;

means for receiving the timing offset signal from each cable modem at the headend;

means for generating at the headend for each cable modem a timing correction message, the timing correction message representing the difference between the actual time of arrival of the timing offset signal at the headend and the expected time of arrival referenced to the headend clock;

means for transmitting the timing correction messages to the respective cable modems;

means responsive to the local clock at each cable modem for generating a continuously incremented local clock timing signal;

means at each cable modem for adding the timing correction message to the local clock timing signal to produce a time slot defining signal corrected for the particular cable modem;

means for transmitting data from each cable modem to the headend in time slots allocated

from the head end responsive to the time slot defining signal so as to place the data from the cable modems in the allocated time slots.

23. The combination of claim 22, additionally comprising means responsive to the master clock for generating at the headend a continuously incremented master clock timing signal, means for generating MAP messages to allocate time slots to the cable modems based on the master clock timing signal, and means for transmitting the MAP messages to the cable modems.

24. The combination of claim 23, in which the synchronizing means comprises means for transmitting the master clock timing signal to each cable modem, means for comparing the master clock timing signal and the local clock timing signal to generate an error signal, and means for correcting the frequency of the local clock responsive to the error signal.